National Transportation Safety Board
Aviation Accident Final Report

Location:	CHICAGO, IL	**Accident Number:**	CHI94MA290
Date & Time:	08/19/1994, 1308 CDT	**Registration:**	IDUPO
Aircraft:	McDonnell Douglas MD-11F	**Aircraft Damage:**	Substantial
Defining Event:		**Injuries:**	267 None
Flight Conducted Under:	Part 129: Foreign		

Analysis

THE AIRPLANE EXPERIENCED A HARD LANDING ON INITIAL TOUCHDOWN. SUBSEQUENTLY, THE NOSE TIRES FAILED, DAMAGE OCCURRED TO THE GENERAL AREA OF THE NOSE LANDING GEAR SUPPORT STRUCTURE, AND THERE WAS FOREIGN OBJECT DAMAGE TO THE #1 AND #3 ENGINES. THE FLIGHT DATA RECORDER (FDR) DATA INDICATED THAT THE INITIAL TOUCHDOWN ACCELERATION HAD A VALUE OF 1.9488 G'S. AT THAT TIME, THE THROTTLE RESOLVER ANGLES INDICATED 52.03, 51.33 AND 49.22 DEGREES FOR THE NUMBER ONE, TWO AND THREE ENGINES, RESPECTIVELY. ALSO, THE FDR REVEALED THAT AFTER TOUCHDOWN, THE AIRPLANE EXPERIENCED FOUR OSCILLATIONS IN THE PITCH AXIS. THE MAXIMUM PITCH ANGLE DURING THIS TIME WAS +5.98 DEGREES NOSE UP, AND THE MINIMUM VALUE WAS -2.46 DEGREES NOSE DOWN. DURING THIS TIME FRAME, SPOILER POSITIONS NEVER EXCEEDED 8.0 DEGREES OF DEFLECTION AND THE NOSE WEIGHT ON WHEELS PARAMETER CHANGED FOUR TIMES.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: THE FIRST OFFICER'S IMPROPER FLARE AND IMPROPER USE OF FLIGHT CONTROLS DURING THE LANDING FLARE/TOUCHDOWN.

Findings

Occurrence #1: HARD LANDING
Phase of Operation: LANDING - FLARE/TOUCHDOWN

Findings
1. (C) FLARE - IMPROPER - COPILOT/SECOND PILOT
2. (C) FLIGHT CONTROLS - IMPROPER USE OF - COPILOT/SECOND PILOT

Factual Information

HISTORY OF FLIGHT

On August 19, 1994, at 1308 central daylight time, a McDonnell Douglas MD-11F, I-DUPO, registered to and operated by Alitalia as Flight 664, and flown by a flight crew of three, experienced a hard landing on runway 22R (7,500' X 150' dry/concrete) at O'Hare International Airport (ORD), Chicago, Illinois. The airplane sustained substantial damage. The 253 passengers and crew of 14 reported no injuries. Visual meteorological conditions prevailed at the time of the accident and the 14 CFR Part 129 flight was operating on an IFR flight plan. The flight originated from Rome, Italy, at 0322.

Flight 664 was a non-stop operation from Rome, Italy to Chicago, Illinois. When the flight arrived in the Chicago area, air traffic control was being handled by the Chicago O'Hare Terminal Radar Approach Control (TRACON). The airplane was cleared for and flew an instrument landing system (ILS) approach to runway 22R, at ORD. The pilot flying was the first officer. He flew the airplane throughout the entire approach and landing on runway 22R. He had been flying for 10 hours and this was the only landing he made during the flight.

The following is a translation (furnished by Alitalia) of the entire written statement of the Captain. A copy in Italian and English is attached to this report:

"On final for Rwy 22R all the parameters were well established. The aircraft was hand-flown with ATS engaged. At 50 feet the plane had a light but evident trend to sink. At 40 feet call-out the pilot flying had already overpowered the auto-throttle but the plane trend to sink went on and the landing main gear ground contact was hard but no so hard to bother me. Also the aircraft nose attitude pitch up was higher than normal but not so high to worry me and to drive me to take control of the flight. The pilot flying pitched down the nose but at the ground nose landing gear contact, unforseeably, the nose went up again. At this point I operated the reverse and the brakes with whole my strength but the nose pitched up for the third time with an attitude so high to cut-off my forward sight of the runway. I was still pushing the control wheel without solution. The nose came down again and struck the ground going up again for the fourth time although I was deflecting the control-wheel fully down. When downed for the fourth time the nose landing gear holded the ground and I was able to take control of the aircraft.

The airport tower controller, who was observing the nose landing gear without tires, told me to stop. I switched off the engines.

We were ready for an emergency evacuation. All the person on board disembarked using a normal stair at 1L door and nobody injured himself or had property damage."

PERSONAL INFORMATION

The Captain was born June 25, 1940. He was the holder of an Airline Transport rating. He had a attained a total of 13,400 hours of flight time with 1,700 hours in this make and model of airplane. His most recent flight check was received on June 16, 1994.

The First Officer was born June 5, 1965. He was the holder of an Airline Transport rating. He had accumulated a total of 3,703 hours with 1,513 hours in this make and model of airplane. His most recent flight check was received on May 19, 1994.

AIRCRAFT INFORMATION

The airplane was a McDonnell Douglas MD-11F, serial number 48429, I-DUPO, registered to Alitalia Airlines of Rome, Italy. The airplane had accumulated 9,390 hours time in service at the time of the accident. The last inspection, an "A" Check, was conducted on August 12, 1994, 45 hours prior to the accident.

FLIGHT RECORDERS

Cockpit Voice Recorder

The cockpit voice recorder was secured after the accident and forwarded to the NTSB Engineer Services Division. On August 30, 1994,a committee was convened to prepare a transcript of the recorded data. It was decided to transcribe the tape for the period of time covering the final approach and touchdown phase of the flight. Voice recordings were found to be mixed English and Italian. An independent translator was present for verification; however, the actual translation from Italian to English was done by the Italian speaking parties in the committee. A complete record of the transcript (Factual Report of Investigation) is included as an addendum to this report.

No additional voice data was heard nor any specifically identified background noises added to the facts, conditions and circumstances involved in the accident.

Flight Data Recorder

The flight data recorder was secured from the accident airplane and forwarded to the NTSB Office of Research and Engineering. A copy of the completed report (Flight Data Recorder Factual Report) is included as an attachment to this report.

The data indicated that at 0009:23 elapsed time, the Flight Management Analyzer (FMA) Format Speed parameter changed state from "Thrust White" to "Retard White." At 0009:25 elapsed time the data indicated that while the airplane was at a radio altitude of -2.0 feet, an indicated airspeed of 150.55 knots, and a magnetic heading of 221.92 degrees, it experienced a normal acceleration of 1.9488 Gs. At this time, thrust resolver angles indicated 52.03, 51.33, and 49.22 degrees for the number one, two, and three engines, respectively. Flap positions indicated a constant 49.927 degrees. The first indication of nose gear contact occurred at 0009:28 elapsed time for one second when the weight-on-wheels parameter state changed to "on-ground" for the first time.

Between 0009:22 and 0009:38 elapsed time, the data indicated that the airplane experienced four oscillations in the pitch axis. The maximum pitch angle observed during this time was +5.98 degrees nose up, and the minimum value observed was -2.46 degrees nose down. During this time frame, spoiler positions never exceeded 8.0 degrees of deflection and the nose weight-on-wheels parameter changed state four times.

At 0009:30 elapsed time, the spoiler arm parameter was observed in the "disarmed position." At 0009:33 elapsed time, brake pressure values for the left and right side increased to 3,372.4 and 3,079.2 PSIA, respectively. At 0009:42 elapsed time, all longitudinal stability augmentations system (LSAS) parameters changed state to "Fail" for 4.5 seconds.

WRECKAGE AND IMPACT INFORMATION

The airplane landed on runway 22R which had a total length of 7,500 feet. The runway was 150 feet wide. The landing surface was grooved asphalt. The initial touchdown point was not

discernable in the residue imbedded in the touchdown area of the runway. The first indication was a small depression and scar at the point where the nose landing gear tires blew out. This location was near the centerline of the runway approximately 300 feet northeast of the intersection of runway 22R and runway 14L/32R. An approximate distance from the approach end of runway 22R to the centerline intersection of runway 14L/32R is 2,800 feet. From that point, until coming to rest about 900 feet from the end of the runway, there was a mark indicating the contact of the main nose landing gear wheels as they wore away on the landing surface.

Substantial damage was sustained by the airframe in the general area of the nose landing gear support structure. There was foreign object damage to both the #1 and #3 engines. There was minor damage to both the left and right hand flaps. A hand written summary of damage is attached to this report.

TESTS AND RESEARCH

The "Autospoiler" logic works as follows:

The auto ground spoilers will deploy during landing when all of the following conditions are met:

1. Two or more Main Landing Gear (MLG) wheel speeds exceed 80 knots.
2. Radio altitude is less than 7 feet and one radio altimeter is valid.
3. Average flap position is greater than 31.5 degrees.
4. Both flaps, or one flap and the flap handle positions are valid.
5. Three or more wheel speed transducers are valid.

Note: If any of the valids mentioned are not present, the "Disarm Spoilers" or "Use Manual Spoilers" alert will appear.

The auto ground spoilers will deploy to the 30 degree position initially when MLG wheel spinup occurs and the above conditions are met; then, they will deploy fully to the 60 degree position at Nose Landing Gear (NLG) touchdown (e.g. at ground sense relay activation in the ground mode).

If the throttles are not retarded to below 46 to 49 degrees Throttle Resolver Angle (TRA) during landing, the assumption is that go-around power is being applied, so the ground spoilers must be retracted immediately to safely facilitate the rejected landing/go around maneuver.

The autospoilers were consistently knocked down (disarmed) at a throttle RTA of 49 degrees on another MD-11 during testing, confirming the 46 to 49 degree tolerance for this safety feature.

The fuel on board the accident airplane was checked post accident and found to approximate the fuel calculations and indications, on landing, for the flight. A copy of the fuel quantity check is attached to this report.

All the baggage and cargo was weighed and found to approximate the manifest weights. A list of the results of the actual weights and location is attached to this report.

A test of the spoiler handle arming forces was conducted on the accident airplane and found to

be about 10 pounds. Reference information received from McDonnell Douglas indicated that although no production steps exist to check the force required to arm the spoiler handle, the subject force was measured on fuselage 449 during flight testing for use with the flight simulator. The force was found to be 10 pounds.

A transcription of the conversations between the Chicago O'Hare Air Traffic Control Tower (ATCT)and Flight 664 was completed by the Quality Assurance Specialist at O'Hare ATCT and is attached to this report.

ADDITIONAL DATA/INFORMATION

Parties to the investigation were the Federal Aviation Administration, Alitalia, McDonnell Douglas, Ministry of Transport of Italy (DGAC), and Registro Aeronautico Italiano (RAI).

The NTSB maintained custody of the flight data and cockpit data recorders from the accident airplane. These pieces of equipment were returned to Alitalia immediately after the data was extracted from them.

Pilot Information

Certificate:	Airline Transport	**Age:**	54, Male
Airplane Rating(s):	Multi-engine Land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	Seatbelt, Shoulder harness
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 1 Unknown	**Last FAA Medical Exam:**	04/11/1994
Occupational Pilot:		**Last Flight Review or Equivalent:**	
Flight Time:	13400 hours (Total, all aircraft), 1700 hours (Total, this make and model), 6900 hours (Pilot In Command, all aircraft), 156 hours (Last 90 days, all aircraft), 65 hours (Last 30 days, all aircraft), 10 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	McDonnell Douglas	**Registration:**	IDUPO
Model/Series:	MD-11F MD-11F	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	No
Airworthiness Certificate:	Transport	**Serial Number:**	48429
Landing Gear Type:	Retractable - Tricycle	**Seats:**	277
Date/Type of Last Inspection:	08/12/1994, Continuous Airworthiness	**Certified Max Gross Wt.:**	620900 lbs
Time Since Last Inspection:	45 Hours	**Engines:**	3 Turbo Fan
Airframe Total Time:	9390 Hours	**Engine Manufacturer:**	GE
ELT:	Not installed	**Engine Model/Series:**	CF6-80C2-D1F
Registered Owner:		**Rated Power:**	60690 lbs
Operator:	ALITALIA	**Operating Certificate(s) Held:**	Flag carrier (121)
Operator Does Business As:		**Operator Designator Code:**	AAPF

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	**Condition of Light:**	Day
Observation Facility, Elevation:	ORD, 668 ft msl	**Distance from Accident Site:**	0 Nautical Miles
Observation Time:	1250 CDT	**Direction from Accident Site:**	0°
Lowest Cloud Condition:	Unknown / 0 ft agl	**Visibility**	5 Miles
Lowest Ceiling:	Overcast / 12000 ft agl	**Visibility (RVR):**	0 ft
Wind Speed/Gusts:	8 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	210°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29 inches Hg	**Temperature/Dew Point:**	29°C / 20°C
Precipitation and Obscuration:			
Departure Point:	ROME, ITALY, OF (FCO)	**Type of Flight Plan Filed:**	IFR
Destination:	(ORD)	**Type of Clearance:**	IFR
Departure Time:	0000	**Type of Airspace:**	Class B

Airport Information

Airport:	O'HARE INTERNATIONAL (ORD)	**Runway Surface Type:**	Asphalt
Airport Elevation:	668 ft	**Runway Surface Condition:**	Dry
Runway Used:	22R	**IFR Approach:**	ILS
Runway Length/Width:	7500 ft / 150 ft	**VFR Approach/Landing:**	None

Wreckage and Impact Information

Crew Injuries:	14 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	253 None	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	267 None	**Latitude, Longitude:**	

Administrative Information

Investigator In Charge (IIC):	STEPHEN A WILSON	**Report Date:**	09/24/1995
Additional Participating Persons:	DANIEL S BALASH; SCHILLER PARK, IL BERNARDO BALESTRA; ROME, ITALY, GIUSEPPE RECCHIA; 00144 ROMA, ITA, STEVEN R LUND; LONG BEACH, CA		
Publish Date:			
Investigation Docket:	NTSB accident and incident dockets serve as permanent archival information for the NTSB's investigations. Dockets released prior to June 1, 2009 are publicly available from the NTSB's Record Management Division at pubinq@ntsb.gov, or at 800-877-6799. Dockets released after this date are available at http://dms.ntsb.gov/pubdms/.		